

The brown bear (*Ursus arctos*) in Holocene Britain: a review of the evidence

Abstract

1. The brown bear, *Ursus arctos*, was Holocene Britain's largest carnivore and has appeared in recent rewilding discussions.

2. Despite widespread interest, we know very little about the species in Holocene Britain as few studies have been undertaken. This paper draws together information on the brown bear to examine the presence and extinction of bears through examination of the archaeological and palaeontological evidence.

3. Data were collected from published literature and museum catalogues. Information on the **chronological date** of the sites, number of specimens, and the body parts present were particularly sought.

4. A total of **86** sites were identified, **57** are well dated, 27 are of uncertain date but likely to be Holocene, and **two have uncertain identifications**. Very few specimens from non-archaeological sites (i.e. fens and caves) are well-dated, skewing the data towards anthropogenic sites such as settlements, castles, and graves.

5. **Analysis of body part representation shows that the bear bones found in the Bronze Age**, Iron Age and most of the early medieval period are from skins. All body parts are present during the Romano-British, medieval, and post-medieval period, indicating that live bears were present, and were probably imported for entertainment.

6. It seems the brown bear was rare throughout the Holocene, and based on current evidence two extinction scenarios can be put forward: extinction in the late Neolithic/early Bronze Age, or extinction in the early medieval period.

Keywords: archaeology, body part analysis, trade, extinction, dating

Running head: Brown bear in Holocene Britain

Word count: 10,000

Introduction

The brown bear, *Ursus arctos*, is found in a wider range of habitats than any other bear species, and prior to human impacts, occurred across Eurasia and North America. It was widespread in Europe during the Lateglacial and early Holocene (Sommer & Benecke 2005), but over the course of the Holocene it was extirpated from many regions (Albrecht et al. 2017). The brown bear was Britain's largest terrestrial carnivore, yet we know surprisingly little about its history, both as a wild animal, and in relation to the human population.

The presence of bears in Britain has implications for humans, as bears would have had a major impact on how people experienced the landscape, and making collecting firewood, woodland clearance or fishing potentially hazardous. Bears occasionally now figure in discussions of rewilding, with headlines such as *"Make way for the lynx and the bear as 'rewilding' projects gather pace across Britain"* (McVeigh 2015) and *"Wolves and brown bears could return to British countryside to 'naturally cut deer population'"* (Knapton 2017). Despite these suggestions (and without getting into the discussion of whether or not this is a realistic aim), we know little about the brown bear in Holocene Britain, although their remains have been reported from the mid-19th century onwards. Two recent analyses (Yalden 1999, Hammon 2010) have amassed the published data, but a critical review is lacking. There are also outstanding questions about when the brown bear became extinct, and whether or not the specimens that we find on archaeological sites are the remains of wild native bears, or those that had been imported from overseas.

This study, building on the work of Yalden (1999) and Hammon (2010), examines Holocene human-bear relationships in Britain, using both osteology and artefactual evidence (where appropriate) to review the evidence for brown bears through time. In a recent comprehensive review of Holocene mammal distributions across Europe, bears were identified as having had a range decline since the Roman period onwards (Crees et al. 2016). The Romans transported live animals by sea and land for the arenas in Rome and this practice must have contributed to extirpations in a number of places

(Bomgardner 1992). However, Crees et al. (2016) also included the presence of bears in Britain into the later medieval period. Large scale overviews such as this are vulnerable to small-scale errors, and interpretations can be affected by the use of data from archaeological sites, where animal remains may have come from several different sources. For example, determining when wild animals were present in the past is not straightforward, particularly when dealing with an animal such as the brown bear where furs (Kirkinen 2017) and live animals (Serra 2013), can be moved and traded over considerable distances and over long periods. The Holocene remains of bears in Britain range from a full skeleton to isolated phalanges, and the sites from caves to human cremations. Therefore, there may be very different sources for animals that are identified within specific sites. This review critically evaluates the record of brown bears in Britain from both anthropogenic and non-anthropogenic sites to examine when and potentially why the bear became extinct, and areas for future research.

Data sources and methods

Data on site location, presence of bear, body part distribution, type of site, and any associated radiocarbon dates were compiled from site reports and review papers. The final dataset comprises 57 sites with bears that can be assigned to a period (Fig. 1), 27 sites that are probably Holocene but do not have well-constrained dates, and two sites that have uncertain species identification. All direct radiocarbon dates on Holocene bear bones are shown in Figure 2 and full data are given in Appendix S1. All radiocarbon dates in the text have been recalibrated using OxCal 4.3.2 (Bronk Ramsay 2009). Time periods (Mesolithic, Bronze Age, etc.) are based on Hunter and Ralston (2009). Sites that are Holocene, but may span two or more time periods are discussed where appropriate. Sites that had a date assigned in Jackson's (1962) review, but have not been subsequently corroborated are regarded as undated, as many are caves containing assemblages from multiple

time periods. Note that in the tables and figures some sites may appear twice if there are bear specimens from multiple periods present. The full dataset of 86 sites is given in Appendix S2.

Spatial and Temporal Distribution

Bears were widespread across Britain in the Lateglacial period, with radiocarbon-dated remains found from Devon in southern England to Sutherland, northern Scotland (Yalden 1999). Recent ancient DNA (aDNA) work on bears from North Yorkshire (Edwards et al. 2014) demonstrated that the matriline of the bears before and after the cold of the Younger Dryas was the same. This indicates continuity of the Lateglacial brown bear mitochondrial lineages into the Holocene, and a potentially rapid recolonisation at the beginning of the Holocene in at least some parts of Britain (Edwards et al. 2014). This matriline (clade 1-i) is also found in Northern Scotland, indicating the persistence of this lineage during the Holocene (Barnes et al. 2002; Edwards et al. 2014). However, there has been no direct date on the Scottish specimen that was sampled for aDNA, so it is not certain when this matriline was present. Despite the presence of bears in the early Holocene, there are relatively few sites with bear in the Mesolithic, declining to very low numbers in the Iron Age, followed by a steep rise from the Romano-British period onwards (Fig. 3). Figure 4 shows the breakdown of the distribution of dated sites by region (see Appendix S2 for categories), and it can be seen that bears are scarce in Scotland, Wales, and the East Midlands, and more frequently found in Yorkshire, the east, south, and London.

Sites with bears are widely distributed in the Bronze Age, Romano-British, and medieval periods, while the post-medieval bears are from London and Edinburgh (Figs.1 and 4). This distribution is explained in Figure 5, which divides the sites into anthropogenic and non-anthropogenic localities. Non-anthropogenic sites are caves, fens, and bogs, while anthropogenic are burials, pits, ditches, and settlements. There is a clear shift in the presence of bears away from 'natural' sites to anthropogenic sites after the Mesolithic. The exceptions are a Bronze/Iron Age specimen from

Inchnadamph, Scotland, and an early medieval specimen from Kinsey Cave, North Yorkshire (see below). The London bias of the post-medieval specimens (Fig. 4) can be directly related to the presence of bear-baiting arenas on the South bank of the Thames (see below).

Analysis of the number of sites in the midlands and south vs. the number of sites with bear (Table 1) indicates that bears are found in 0.9% to 2.5% of sites in each period, except for the post-medieval period when this jumps to 4.7%. These figures indicate that bears are always a rare part of faunal assemblages, although it should be noted that these are archaeological sites, and bears from sites with no archaeology (e.g. caves) are less likely to have good dating associated with them (see Appendix S2). This pattern can be compared with that seen by Albrecht et al. (2017) who found that the probability of detecting Holocene bear remains in 'wild' habitats such as moors or caves were similar to those from archaeological settlements, while detection of specimens from burials were much higher, which may be related to specific cultural practices as discussed below.

Mesolithic 9600 - 4000 BC

Five Mesolithic sites in Britain have bear remains. These are Star Carr (Noe-Nygaard 1983, Edwards et al. 2014), Raven Scar Cave, Victoria Cave (Edwards et al. 2014), Shaws (Smith 1879, Kitchener & Bonsall 1997), and An Corran (Bartosiewicz 2012). Raven Scar Cave contains the remains of one adult bear and several cubs, and it has been suggested that these could be the remains of animals that died during hibernation (Edwards et al. 2014). If the cubs are also Mesolithic (they are currently undated), this would be first direct evidence for the hibernation of bears in Holocene Britain.

Victoria Cave has evidence for human activity in the Lateglacial and later Holocene (e.g. Lord et al. 2007, 2012; Branigan & Dearne 1992), but not for the Mesolithic. The lack of evidence for human interaction with the Mesolithic bear remains from Victoria Cave and Raven Scar Cave suggests that these specimens represent a natural accumulation of animals, without human intervention, with Lord et al. (2007) suggesting that cave entrances may have become blocked and inaccessible in the

later Mesolithic. In contrast, Star Carr is an archaeological site on the edge of former Lake Pickering in North Yorkshire that was used repeatedly in the early Mesolithic (Conneller et al. 2012). Three bear bones have been found at the site – an axis vertebra (Noe-Nygaard 1983), an upper canine (Edwards et al. 2014), and a mandible (Legge & Rowley-Conwy 1988; Yalden 1999). Star Carr is unusual in the size and richness of the assemblage, and the presence of multiple antler headdresses that may indicate ritual activity (Clark 1971; Conneller et al. 2012). The presence of parts of the skull and the second cervical vertebra indicates that at least one head was collected, which could potentially have had a ritual purpose (ethnographic sources indicate that the skull of a bear including the first and second cervical vertebrae is often treated differently to the rest of the carcass and may be used ceremonial activities; Germonpré & Hämmäläinen 2007; Garshelis 2009). Alternatively, they could be isolated specimens collected as curios over the 200-300 hundred years that the site was in use (Conneller et al. 2012). A complete but eroded first phalanx was found in a midden context in An Corran rockshelter on Skye (Bartosiewicz 2012). It has been suggested to be from a skin (Kitchener et al. 2004), or possibly from a bear that was killed on the island (Bartosiewicz 2012). The majority of the stone tools from the site are Mesolithic, as is a radiocarbon date from a bovid bone from the same context as the bear, but radiocarbon dates of bone tools and human remains have shown a greater spread into the Neolithic and Bronze Age, so there is a possibility that the bear might have a later date, but it has been counted as Mesolithic here. A bear cranium and rib was recovered from “the bottom of the peat, and lying on the marl, or nearly so” at Shaws in Dumfriesshire in the late 19th century (Smith 1879). The specimen is largely edentulous, but those teeth that remain (both canines and the left M2) appear very worn. The combination of marl and/or peat suggests the Shaws bear was inhabiting a boggy if not wetland environment, while Star Carr was on a swampy lakeshore, which succeeded into fenland with nearby willow and birch woodlands (Taylor 2011).

The status of a single radiocarbon dated specimen from Kent’s Cavern is currently uncertain - Yalden (1999) cited Campbell (1977) as the source of the information, but I have been unable to locate it in that volume, so it has not been included here. Radiocarbon dating of two bears from the ‘Mesolithic’

layer at Foxhole Cave, Derbyshire (Bramwell 1971), has resulted in Lateglacial dates (O'Regan unpublished). While Bramwell (1971: 8) also listed bear specimens from later layers within the site, he noted 'the broken condition of their bones'. Cave stratigraphy is often disturbed and with the activity of water, badgers, etc., often specimens of very different ages can be found together (Dowd 2015), perhaps increasing the likelihood that any bears found in 'Neolithic' layers in Foxhole are also from earlier deposits. Of the sixteen specimens radiocarbon dated for Edwards et al. (2014), only three were Mesolithic, and the rest were Lateglacial. This may indicate that substantial numbers of radiocarbon dates are needed to find these later bears amongst the larger number of Lateglacial specimens or that a true pattern of early Holocene scarcity is emerging.

The Neolithic 4000 - 2400 BC

Yalden (1999: 114-115) listed four sites as Neolithic – Victoria Cave, Elbolton Hole, Great Orme's Head, and Foxhole, five as late Neolithic- Barholm, Rain's Cave, Down Farm, Northborough, and Letchworth, and five as possibly Neolithic – Greater Kelco Cave, Windy Knoll, Rhosddigre Cave, Burwell Fen, and Manea Fen. Hammon (2010) added two Neolithic sites – Etton and Eynesbury, and two Neolithic/Bronze Age sites – Maxey Quarry and Eton Rowing Lake. There is also a possible specimen from Skara Brae, Orkney. Taken as a whole this gives a potential total of 19 sites with bear in the Neolithic. However, Northborough (in Yalden 1999) and Etton (in Hammon 2010) refer to the same site and specimen – a single canine from pit F538 at the A15 Bypass site between Northborough and Etton (Wallace 2005). The only bear specimen (a canine) from Greater Kelco Cave was radiocarbon dated twice by Edwards et al. (2014). The first sample failed to date and the other dated to the Lateglacial. The presence of this single specimen was interpreted as a tooth that had been collected from another cave and deposited by people in a later period, as were the two terminal phalanges found at Sewell's Cave that also dated to the Lateglacial (Edwards et al. 2014). In summary, the specimens from cave sites that have been dated have all proved to be earlier than the

180 Neolithic, raising questions about several more (Victoria Cave, Elbolton Pot, Windy Knoll, Foxhole,
181 and Rhosddigre) that remain to be dated.

182 Away from caves, three specimens have been found in the East Anglian fens. These include a
183 complete skull from [Manea Fen \(Owen, 1846\)](#), and an isolated mandible and complete skeleton from
184 [Burwell Fen \(skull illustrated in Reynolds 1906\)](#). No dates are available for any of these specimens,
185 despite the Burwell bear being the only complete skeleton from Holocene Britain. However,
186 considerable work has been undertaken to date other bones from Burwell, and while the peat (and
187 therefore presumably the bear) is Neolithic to Bronze Age, human remains from the fen have been
188 dated to much later periods (Hedges et al. 1994). There is an additional undated fen specimen, a
189 scapula from Skipsea in North Yorkshire (Ogilvy pers. comm.), which could potentially be Mesolithic,
190 Neolithic, or later.

191 The specimens from archaeological sites are more securely dated. Nearly all of them were found in
192 pits or ditches (the exception is the specimen from Barholm, which may be from the floor-level in a
193 hut; [Simpson 1993](#)). Only one specimen is related to a burial site - a lower canine from the tertiary
194 ditch fill of a long barrow at Eynesbury, Cambridgeshire (Sykes 2004). This tertiary fill postdated the
195 creation of the barrow and contained both Neolithic and Bronze Age archaeology, so the bear could
196 be from either period.

197 There is an intriguing distribution of body parts at the dated Neolithic sites ([Fig. 6b-c](#)), as all
198 specimens are from the skull or front leg. Three of these leg specimens are scapulae, which do not
199 usually have a ceremonial function, although scapulimancy - a form of divination that utilises the
200 scapula (e.g. [Hallowell 1926](#); [Moore 1957](#)) - is a theoretical possibility. The scapulae are from
201 Barholm (Harman 1993), Ratfyn (Jackson 1935), and Eton Rowing Lake (Hammon 2010), the latter
202 suggested to date to the Neolithic/Bronze Age. At Barholm, charcoal from the base of a pit
203 underlying the context with bear was dated to 3347-2582 BC (Simpson 1993; Pearson 1979). The
204 bear must postdate this, and the presence of horse in the same context as the bear (Harman 1993)

205 may signal that it is either a mixed Neolithic/Bronze Age or Bronze Age deposit, as horses are very
206 rare or possibly absent for most of the Neolithic (Bendrey 2010). A single bear ulna from Pit 11a,
207 Firtree Field, Down Farm, Cranborne Chase, was from a pit that contained the largest animal bone
208 assemblage from the site, including a complete cattle skull (Legge 1991). The size of the assemblage
209 may indicate that this was a special deposit, but multiple bones including the bear had been gnawed,
210 which also suggests that the specimens were lying around, chewed by the local dogs and then
211 disposed of (Legge 1991).

212 The specimens from the skull may be easier to explain, as they can be collected as curios,
213 ornamentation, or have some ceremonial function, while, with the exception of claws, there is less
214 importance attached to the rest of the bear skeleton (Germonpré & Hämäläinen 2007). The isolated
215 postcrania may have had a function that we no longer understand, be curios picked up on peoples'
216 travels, or represent the incorporation of bones that were present at the sites into pit fills with no
217 other intentions. Currently, there is not enough evidence to tell these options apart (and more than
218 one may apply in some cases).

219 There are doubts over whether one of the Neolithic specimens is bear or not. This is a single tooth
220 from Skara Brae in Orkney that has been made into a pendant, but is identified only as ?bear in the
221 British Museum catalogue (reference number 1938.0101.37).

222 Therefore, of the 19 sites that were originally suggested to be Neolithic, eleven need radiocarbon
223 dating to confirm that they are Neolithic, two (Northborough and Etton) are the same site, and one
224 (Skara Brae) needs further work to identify the species involved. Only four are securely dated to the
225 Neolithic, while Maxey Quarry, Eton Rowing Lake, Barholm and Eynesbury are either Neolithic or
226 Bronze Age.

227 Overall, bear remains in the Neolithic (and Neolithic/ Bronze Age) are mainly found in the East and
228 southwest of England (Figs. 1 and 4). This is intriguing, and suggests that either bears were able to
229 survive in the Neolithic in anthropogenic landscapes containing monuments such as henges and

230 cursuses (Whittle 2009), or that they were culturally important enough for people to be transporting
231 their remains from elsewhere in Britain or overseas. Both possibilities have considerable implications
232 for our understanding of the extinction of brown bear and human activities in Neolithic Britain. In
233 terms of human-wildlife conflict, the Neolithic probably represents the period when this would have
234 come to the fore (Yalden 1999). The importation of domesticated cattle, sheep, and pigs would have
235 provided a potential new food source for brown bears, and brought them into conflict **with people**.
236 Domestic livestock were heavily preyed upon by bears following their introduction into parts of North
237 America in the 19th century, resulting in a bounty and reduction of bear numbers from 50,000 to a
238 few thousand within 100 years (Garshelis 2009). People in the Neolithic would certainly have wanted
239 to protect their animals, and brown bears, which may already have been at low numbers in the
240 landscape, could have been extirpated **quite rapidly**.

241

242 *The Bronze Age 2400 - 800 BC*

243 There is only one record of brown bear from the Bronze Age in England (in addition to those
244 identified above as **Neolithic/Bronze Age**); a skin found in a burial at Whitehorse Hill on **Dartmoor**
245 **(Jones 2016)**. This is a unique find as, archaeologically, skins are usually only represented by claws
246 after the flesh has rotted or been burned away. The anaerobic conditions within the bog preserved
247 the skin, which had been wrapped around a human cremation and placed in a **cist** (Jones 2016).
248 Currently there is no way of telling if this skin was from a local bear or had been imported, although
249 the authors suggested it may have been from native bear. Recent work has demonstrated
250 considerable movement of people in the Bronze Age in Britain and from overseas (Parker Pearson et
251 al. 2016), and it is possible that the skin could have been imported as a curio or item of special
252 status, rather than being from Britain. The only other find that may date to the late Bronze
253 **Age/earliest** Iron Age is a bear femur from Inchnadamph in Scotland that was radiocarbon dated to
254 969-776 BC (Burleigh et al. 1976). This was dated in the early days of radiocarbon dating and would

255 benefit from repeating with modern AMS techniques. Ancient DNA from an undated bear tooth
256 from the same cave showed that it was from the same haplogroup as the Mesolithic brown bears
257 from the Yorkshire Dales (Barnes et al. 2002; Edwards et al. 2014). This might indicate that
258 Sutherland was a refugium for the brown bear, but further work is required to confirm this.

259

260 *Iron Age (800 BC - AD 43)*

261 Only two sites with bears are dated to the Iron Age and they are both graves in the East of England
262 dating between 50-1 BC (Schönfelder 1994). At Welwyn Garden City six burned **distal** phalanges
263 were found mixed with the cremated remains of a human male and were interpreted as the body
264 having been wrapped in a skin before cremation (Stead 1966). Three burned phalanges were found
265 at Baldock, also **mixed with** the remains of a cremation (Stead & Rigby 1986). Schönfelder (1994)
266 found parallels for graves with bear claws in Germany and Scandinavia, emphasising that the two
267 burials from Britain were from high status individuals, and that their graves contained a number of
268 imported goods. The lack of holes in the claws indicates that they were not being used for pendants
269 (Schönfelder 1994), and suggests that pelts with the claws still attached were included in the
270 cremation ritual. A wide variety of animal images were used in the Iron Age, e.g. in East Anglia,
271 wolves, boars, and horses were depicted on coins, and boars, ducks, and bulls as figurines or on
272 objects (Davies 2011). There are at least two depictions of bears on coins (Cottam et al. 2010), but
273 no figurines, which seems a strange omission when other large powerful animals were represented,
274 and could indicate that bears were missing from the landscape or were tabooed. **Allen & Sykes**
275 **(2011)** discuss Iron Age attitudes to the wild and suggest that wild animal remains are missing from
276 sites because there was a deliberate distancing of human society from the natural world at **the** time.
277 However, many of these animals were still represented in art, while the bear was not. The lack of
278 specimens and iconography suggests that the bear was absent, at least in southern and eastern
279 England, during the Iron Age.

280

281 *Roman AD 43-410*

282 There are 10 well-dated anthropogenic sites with bears from Roman Britain, with the possibility of
283 five others. The latter are a metapodial from a probable Roman context in Whitchurch (Madgwick
284 pers. comm.), a metacarpal from late Scottish Iron Age/medieval Tirefour on Lismore in the Inner
285 Hebrides (Orton pers. comm), a scapula from near Richmond (Boyd Dawkins 1865), two tibiae and a
286 mandible from a deposit that is probably Romano-British at Binchester Roman Fort (Jessop 2012;
287 Stallibrass 2002), and an unknown specimen listed as ?Roman by Yalden (1999) from Little Hoyle in
288 Pembrokeshire. The sites are found from the South coast (Westward House near Fishbourne Roman
289 Palace in Sussex) to Binchester in County Durham (Fig. 1). A humerus identified as bear from the
290 London Amphitheatre excavations cannot be confirmed, as the specimen was missing when the final
291 report was compiled (Bateman et al. 2008: 129).

292 Martial mentions, in Epigram 9, the presence of Caledonian (Scottish) bears in the amphitheatre in
293 Rome in the late 1st century AD (Coleman 2006). However, we need to be a little cautious in
294 interpreting Martial's writing as confirming that bears were still extant in Britain at the time, as the
295 bears in Rome could have been continental bears that had been exoticised and marketed as from
296 the edge of empire for the populace of Rome (Crummy 2010). In Britain images of bears are largely
297 seen on pottery including Samian bowls, a vase from Colchester showing a man with a whip and a
298 bear (Toynbee 1964), and one of the pieces of the Mildenhall treasure (the latter items were made
299 in Britain, but the Samian was imported). Bears were also depicted on mosaics from Roman Britain,
300 but in lower numbers than some other exotic taxa (e.g. leopards are shown 25 times, lions 15, and
301 bears 4) (Witt 2016). All representations of bears are on Orpheus mosaics, which depict Orpheus
302 playing his lyre to subdue the wild beasts (Witt 2016). The bears are in naturalistic poses but not
303 well-executed, and it is likely that the mosaicists had not seen some of the species that they were
304 depicting.

There are rare three-dimensional figurines of bears from Roman Britain, including a Roman copper alloy figure of a bear holding a small figure (possibly a child) in its jaws (Evans & Mackay 2004). This was suggested to be a funerary figurine, which could link it with the seven jet bears from late Roman children's graves or sites of cultic activity in Colchester, York, and Malton (Crummy 2010). Parallels for these bears in Britain have also been found in Trier and Cologne (Crummy 2010).

Stallibrass (2002) noted a number of Romano-British sites with bear in the North East (Catterick Bridge, Binchester, Richmond), and suggested that the bear could possibly represent a cultural connection between the inhabitants of these three sites. With the exception of a single mandible from late Iron Age to early Roman Sheepen (Luff 1985), all other well-dated Romano-British specimens are from the 3rd-4th centuries AD. These dates fit with those of the Orpheus mosaics (Witt 2016) and the jet bears (Crummy 2010), and suggest a gap in our record of bears in Britain in the early-mid Romano-British period. Martial's reference to Caledonian bears in the 1st century AD (Coleman 2006), if taken at face value, and the absence of bears between ~AD 50-250, might suggest that they were quickly extirpated by Roman trading. With the exception of the probably Roman finds from Binchester Roman Fort, all of the skeletal specimens of bear are from towns or villas. The body part representation (Fig. 6f) suggests that entire (and probably live) bears were present during the later Roman period, and the distribution of sites suggests that live bears were being imported for civilian rather than military purposes, with the entertainments suggested by Luff (1985) to have included dancing and/or baiting. However, it is just possible that bears could still have been hunted in the northern Pennines (Stallibrass 2002).

Early medieval (includes Viking and Anglo-Saxon periods) AD 410 - 1066.

Eight sites with bear are known from the early medieval period, in addition to the specimen from Lismore mentioned above. Four sites are Anglo-Saxon cemeteries in the East of England, where phalanges have been found in multiple cremation urns: Cleatham (n = 5 urns, with possible bears in

330 another 5 urns; Squires 2011), Elsham Wold (n = 6 urns; Squires 2011), Sancton (n = 2 urns; Bond
331 1996), Spong Hill (n = 6 urns; Bond 1996). **Distal** phalanges are most commonly reported, **but Elsham**
332 Wold and Cleatham also have **proximal or intermediate** phalanges present, and Cleatham also has a
333 possible unfused diaphysis fragment (Squires 2011). The highest number of phalanges from a single
334 urn is 10, found at both Elsham and Cleatham (Squires 2011). Staying with the foot, a second
335 metacarpal was found at Anglo-Saxon West Stow in Suffolk (Crabtree 1989), **a phalanx** at Eynsham
336 Abbey (Hardy et al. 2003), and two **distal** phalanges from Viking-Age Coppergate in York (O'Connor
337 1989). A single canine pendant from the Brough of Birsay with a runic inscription may be from either
338 a seal or a bear (Morris 2017). Finally, and perhaps most surprisingly, the cervical vertebra of a bear
339 from Kinsey Cave in North Yorkshire has been radiocarbon dated to AD 425-594 (Taylor et al. 2007),
340 making it the latest specimen from a non-anthropogenic site in Britain. However, this site also has
341 evidence for Romano-British cultic activity and the latest radiocarbon date for a lynx (*Lynx lynx*) in
342 Britain (Hetherington et al. 2006). There is a possibility, albeit faint, that this bear could be the
343 descendent of a bear imported into Britain for Roman entertainment, rather than a wild animal. If it
344 is from a wild native bear, then this suggests that the Yorkshire Dales, despite being a major mining
345 area in the Roman period, retained some vestiges of wilderness into the early medieval period.

346 Claws in cremations and occupation sites suggest the presence of skins. Phalanges are often
347 included within furs, despite their presence making it harder to skin the specimens (Kirkinen 2017).
348 Skins tend not to have metapodials left in them, so it is possible that these were used for another
349 purpose. However, given the rarity of bears in the early medieval period, it is most likely that all the
350 specimens from anthropogenic sites represent skins that had been traded.

351 Unlike several other wild animals such as wolf and beaver, there is a lack of convincing Anglo-Saxon
352 bear place name evidence in England (Aybes & Yalden 1995), suggesting that they were very rare or
353 extinct by this time. There also appears to be a lack of bears in early medieval iconography, with the
354 exception of Viking Age hogbacks. Hogbacks are large carved **stones, thought to have been grave**

355 covers or markers, and mainly found in northern England and southern Scotland (Williams 2016).
356 There are a great variety of types (Cramp 1991), some of which have animals at each end (termed
357 'end-beasts') apparently grasping the main body of the stone. Some of these end-beasts appear to
358 be bears, such as the three from Brompton in Yorkshire (Williams 2016), but the carving of bears on
359 such objects does not necessarily indicate that bears were present in the region, rather they are
360 likely to have had some protective purpose for the dead. The most convincing depiction of a bear
361 from this period is a Pictish carving from Old Scatness on Shetland (Bond & Bashford 2010). This
362 carving shows a bear walking from left to right, with a clear hump between the shoulders. It really
363 gives the impression that the artist had seen a bear, but bears were not present in Shetland and the
364 similarities of style with other Pictish carvings suggests that the artist may have been from the
365 Scottish mainland (Dockrill & Bond 2010).

366 In summary, the data for bears in early medieval Britain is very sparse, and the osteological remains
367 are limited to foot bones (Fig. 6g) that are likely to be the remains of imported skins rather than
368 bears themselves. The exception is the single radiocarbon dated specimen from Kinsey Cave, which
369 suggests that live bears were present in the Yorkshire Dales into the earliest medieval period.

370

371 *Medieval and post-medieval AD 1066 - Victorian*

372 Twenty-one sites with bear remains are known from the medieval and post-medieval periods. Those
373 from the medieval period (AD 1066-1485) are a mix of single phalanges (five sites) and other body
374 parts (e.g. radius, calcaneum, maxilla) (five sites) (Fig. 6h). Sites with phalanges are likely to have had
375 skins, those with dentition (Colchester, Carlisle) could be from trophies or live animals, while those
376 with multiple body parts are likely to represent live bears (Barnard Castle; Plantation House, London;
377 Gaol Street, Hereford). For the post-medieval period (AD 1485 onwards), five specimens were
378 reported from a former anatomy school in Edinburgh (Henderson et al. 1996), with others from
379 Vintner's Hall, a Victorian furrier's or taxidermist in London. All other post-medieval sites are in

London and associated with bear-baiting in Southwark. All body parts are represented here, and with the corroborating evidence from images and documentary archives it is clear that live bears were being imported for baiting (e.g. Ravelhofer 2002; Bowsher 2012; MacKinder et al. 2013). While baiting was performed all over the country, no bears from this period have been found outside London. This may indicate that the bears were rarely killed during baiting, or may be more indicative of the fact that the archaeology of the post-medieval has traditionally been less studied as it coincides with better historical records. A record of two bear skeletons from post-medieval Skinmarket Place mentioned in Bowsher & Miller (2009) appears to have been an identification error (LAARC 2017).

Bears were present in the Royal Menagerie at the Tower of London (Parnell 1999) and continued to be imported into Britain until well into the 20th century. Dancing bears were a common entertainment, with certain groups making their living from travelling with their bears in the summer (Serra 2013). Bears were also widely used for their body parts, with bear's grease, used for encouraging the growth of hair, still being sold in Britain in the early 20th century.

In summary, there is extensive evidence for the exploitation of bears in the medieval and post-medieval periods, but no evidence for wild bears in the countryside.

Wanted alive or dead?

Analysis of the body part distribution of bears through time demonstrates that there are only two records of bears from Britain in the Iron Age, and these are both sites with cremated distal phalanges (Fig. 6e). A similar pattern is seen in the early medieval period (Fig. 6g) where almost all specimens are phalanges or metapodials from settlement sites, which are likely to have come from skins.

403 Examining the number of specimens per site shows that well over half the dated sites have a single
404 bear specimen, and only five sites have ten or more bear bones (Fig. 7). Raven Scar cave in the early
405 Mesolithic has evidence for multiple individuals (one adult and several cubs), while post-medieval
406 Vintner's Hall has at least five individuals present (Hammon 2010). These low numbers contrast with
407 those of the Lateglacial period, where Lord et al. (2007) estimated a minimum number of seven
408 individuals for Victoria Cave and five individuals for Kinsey Cave. While it is possible that the cave
409 entrances were blocked with scree during the Mesolithic period (Lord et al. 2007), perhaps reducing
410 the chances of bears using these caves, there seems to be a real pattern of scarcity emerging for
411 brown bears in Holocene Britain. This is in contrast to the situation in Ireland, where bears appear to
412 have been exploited in the Lateglacial and Mesolithic (Dowd & Carden 2016), and are present in
413 caves in the Neolithic and Bronze Age (Edwards 2014).

414 There are very few bears present in Bronze Age and Iron Age Britain (Fig. 3), a pattern that is also
415 seen in lynx (Crees et al. 2016). The lynx is always rare and Crees et al. (2016) suggest that its scarcity
416 between the Neolithic and Roman periods is likely to be due to a lack of finds rather than extinction
417 (it is only known from five Holocene sites in total) but, as noted above, the site with the latest lynx in
418 Britain, Kinsey Cave (Hetherington et al. 2006) is also with one with the latest bear (Hammon 2010).

419 Examination of the body parts present on individual sites (Fig. 6) provides a much more nuanced
420 approach to understanding bear distributions than the collation of presence/absence data alone.
421 For sites where multiple bear body parts, or parts of the long bones are present, it is likely that live
422 bears were present. Here I argue that these are likely to have been imported for entertainment from
423 the Romano-British period onwards, although Hammon (2010) suggests that those from the Roman
424 period might still represent the indigenous population. The most straightforward explanation for
425 those sites that have only foot bones present, is that the bones relate to skins or furs. However,
426 while fur trading could be purely economic, there are also other, less tangible reasons for the
427 collection or curation of bear remains. For example, Oehrl (2013) discusses the relationship between

methods of bear hunting and the courage of the people involved, where hunting the bear on foot or horseback, and attacking it from the front armed with a sword was regarded as the bravest act, while stalking from behind “should not be praised at all” (Oehrl 2013: 303, citing Hadamar von Laber; early 14th century). In this environment, the inclusion of bear remains in a grave may indicate something of the nature of the person who had been buried, rather than the presence of bears in the locality. Disentangling these different issues is well beyond the scope of this paper, but they are worth considering in a zoological context when assembling data on the presence of wild animals and using them to reconstruct past distributions.

Extinction - theories, factors, timing.

When and why did the brown bear become extinct in Britain? At present this question is impossible to answer, as there is still much we do not know about its distribution. As well as the 57 sites that have well-constrained dates there are an additional 27 that are thought to be Holocene, but have no further information (Appendix S2). For radiocarbon-dated specimens, there is a gap of some 4,000 years from the early Mesolithic to the latest Bronze Age/earliest Iron Age (Fig. 2). Some of this gap is filled with specimens from archaeological sites, but further radiocarbon dating is needed to establish a clearer idea of bear distribution in the past. However, there are some factors that would undoubtedly have contributed to the bears decline, which include human-bear interaction/competition, changing habitats, and the size of the bear population.

Human-bear interaction can encompass many forms. These will include the direct dangers that bears pose for humans as much larger and carnivorous animals, as well as competition for resources, such as the predation of domestic animals, crops, and hives. Humans and bears may also have wanted to use the same locations, for example bears using caves for denning, which were also being used by humans for occupation or for burying their dead. Recent work by Albrecht et al. (2017) has identified a combination of climate change and landscape change through human activity as the main drivers

453 of bear extinction in Holocene Europe. Habitat fragmentation may have resulted in smaller
454 populations that would have been more vulnerable to extinction. For example, in a non-
455 anthropogenic context, Leonard et al. (2013) used a population viability analysis to determine that
456 bears were very unlikely to have survived in a Last Glacial Maximum refugium in southern Ireland. In
457 contrast, recent genetic work on the very isolated population from the Apennines in Italy, has shown
458 that the bears probably became isolated in the Neolithic, and that certain genetic adaptations may
459 have increased the likelihood of their survival (Benazzo et al. in press).

460 There is very limited evidence for direct interaction between humans and bears, such as cutmarks or
461 burning on the bones. This is particularly apparent in prehistory, where cutmarked bear bones from
462 Ireland have been dated to the Lateglacial and early Mesolithic (Dowd & Carden 2016), but Lord et
463 al. (2012) specifically comment on the lack of cutmarks on Lateglacial bear bones from Victoria Cave.
464 For later periods, at least six sites have clear evidence of human-bear interaction. Two are Romano-
465 British - the Westward House phalanx has cutmarks, the Fullerton specimens are slightly burnt, three
466 are medieval - a proximal phalanx with cutmarks from Wigmore Castle, a butchered maxilla from
467 Colchester and a butchered scapula from Seal House, London, and one is post-medieval - two tibiae
468 with cutmarks from Southwark. The Colchester bear from Long Wyre Street also had an infected
469 maxilla, which could have resulted from the accidental or deliberate breakage of the canine (Luff &
470 Brothwell 1993). Both the Westward House and Wigmore Castle finds are consistent with skins
471 (although modern furriers would remove the proximal phalanx; Kirkinen 2017).

472 There is a distinct lack of bears in Wales and Scotland - in part because sediments are not good for
473 preservation, caves (the source of many non-anthropogenic samples) are rarer, and also because, in
474 the case of Wales, there has been less intensive study of the material. Almost all known bears from
475 Scotland have been radiocarbon dated (Appendix S1), but there are very few overall. The specimens
476 from Skye and Lismore are both foot bones, which may suggest they were imported as skins rather
477 than inhabiting these islands.

Woodman (2015: 26-28) points out that the carcasses of hunted animals may be butchered on the spot, meaning that their bones are likely to be scarce on sites. Therefore absence of evidence is not evidence of absence, and when dealing with an animal that has as many cultural connotations as the bear it is very hard to disentangle what might be true presence, from anthropogenic manipulation that could go back into the Upper Palaeolithic (Germonpré & Hämäläinen 2007). Whatever the situation, almost one third of the probable Holocene occurrences of brown bear in Britain are undated, so the picture outlined in this review may change in future.

Conclusion

This study has demonstrated that examining the presence of wild species, particularly those that have great cultural value, can lead to misinterpretations of the presence or absence of that animal, unless considerable care is taken when collecting the data. The body part representation of the animal is critical to understanding whether it is likely to have been alive or dead at particular sites. Examination of the record of brown bear in Britain shows that it is only represented as skins in the Bronze Age, Iron Age and most of the early medieval periods, while live animals are likely to have been present in the Neolithic, Romano-British, and medieval and post-medieval periods. It appears bears were always rare in Holocene Britain, particularly after the Neolithic/early Bronze Age, when they might have been largely extinct, with the exception of northernmost Scotland and possibly the Yorkshire Dales. Therefore two scenarios for bear extinction suggest themselves based on the current data, and which may be tested in future: 1) the bear became extinct in the late Neolithic/early Bronze age and all other findings represent imported specimens (alive or dead) or 2) bears remained present, but in low, almost undetectable numbers until the early medieval period, before finally becoming extinct. However, more research, particularly on the many undated specimens from caves and fens will be required before a clearer pattern of brown bear distribution and extinction emerges.

503

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509

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732

Period	No of sites	No of sites with bear	Percentage with bear
Mesolithic	4	0	0
Neolithic	162	4	2.5
Neolithic/Bronze Age	32	4	11.8
Bronze Age	73	1	1.4
Iron Age	160	2	1.3
Romano-British	176	9	5.1
Early medieval (Saxon)	231	3	1.3
Medieval	537	5	0.9
Post-medieval	214	10	4.7

733

734 Table 1. Sites with bear as a proportion of the total number of sites for each period in the Midlands,
735 East, South, and South West of England. Site data taken from Historic England geographic reviews:
736 [Midlands and East Anglia \(Mesolithic to post-medieval; Albarella and Pirnie 2008\)](#); [South and](#)
737 [Southwest \(Neolithic to Iron Age; Hambleton 2008; Serjeantson 2011; Saxon, medieval and post-](#)
738 [medieval ; Holmes in press\)](#). Where reviews overlap I have attempted to remove one of the datasets
739 so that sites are not counted twice. The sample of Saxon/Norman sites in Holmes (in press) was
740 divided and half added to the Saxon count and half to the medieval count. The presence of bear has
741 been limited to those regions included in the reviews to make the data directly comparable.

742